TRANSACTIONS
OF THE
ILLUMINATING ENGINEERING SOCIETY

FOUNDED IN LONDON 1909

INCORPORATED 1930

PUBLIC LIBRARY MAR 5 1946

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VOLUME XI.—No. 1
JANUARY, 1946

32 VICTORIA ST
LONDON, S.W.1

SESSION 1945—1946

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THE NEW I.E.S. CODE

By H. C. WESTON *(Fellow)*

(Introductory remarks of Mr. H. C. Weston at the Sessional Meeting held on November 13th, 1945)

In June, 1941, a meeting was called of the Panel, as it then was, appointed to consider the revision of the I.E.S. Recommended Values of Illumination, and the last item on the agenda was "to consider the addition, as an appendix, of supplementary explanatory matter dealing with quality of lighting (in addition to mere values of foot-candles), recommendations for avoidance of glare and glitter, provision of light-coloured surroundings, etc."

In 1942, the fourth version of the Recommended Values was issued, and the title "I.E.S. Code" was then used for the first time. This version contained a short preface drawing attention to the importance of factors affecting what is, perhaps conveniently, termed the quality of lighting, together with two pages of explanatory matter relating to values of illumination.

But, although it was felt that no radical change in the scope of the Code, nor in its general classification of visual tasks, and its familiar range of values, should be made during the war, chiefly because the recommendations of the Code had been accepted as standards for the lighting of vital factories, the Panel had under consideration from 1941 onwards, the formulation of a more comprehensive and soundly based Code.

They proceeded, therefore, to consider the results of a number of relevant scientific investigations, so that due account should be taken of them in drafting the provisions for the new Code, which would, accordingly, derive its sanction as much as possible from such findings. Some of these investigations were those made in consequence of the proposals put forward by Mr. A. W. Beuttell, the first chairman of the Panel (originally set up early in 1932), in his original paper on "An Analytical Basis for a Lighting Code." This paper was read before the Society more than two years before the Recommended Values of Illumination were first issued in March, 1936.

The Code Panel, which has now become a Standing Committee of the Council, planned to have the new Code ready for issue as soon as hostilities ceased. They have "delivered the goods" on time.

Doubtless the product of their labours has its shortcomings and imperfections. Nevertheless, I introduce the new Code with some confidence that it will meet with general approval, as being a more complete, more rational, and more useful document than its predecessors. But, like its predecessors, it will be subjected to revision from time to time, as the need for this becomes apparent.

We believe, however, that in some respects, certainly in respect of the factorial method adopted for ascertaining recommended values of illumination, the new I.E.S. Code gives a lead that may well be followed in the post-war Codes of our fellow Societies in other countries.

The Code is self-explanatory, and I shall, therefore, confine these introductory remarks to some of its salient features.

It is primarily intended for the guidance of those professionally engaged in planning and installing lighting, and their experience and skill will usually be required in applying

its recommendations. It will also guide the consumer in formulating his lighting requirements, or he may require compliance with it as a condition of any contract given for lighting.

The Code defines Good Lighting in terms of amenity and utility. Lighting is good if it is suitable, in quality and quantity, both for creating agreeable environmental brightness, and for permitting high efficiency in seeing what it is essential should be seen in any particular case.

It is divided into two parts dealing, respectively, with natural and artificial lighting. It also includes notes on assessing the amount of illumination required, together with a schedule of pre-determined values for a large number of specific "visual tasks."

An innovation is the specification of numerical values of illumination, throughout the Code, in terms of lumens per square foot instead of foot-candles. The use of this—as I think—more rational expression for values of illumination does not, of course, involve any numerical change. It may be recalled that, since illumination is defined in terms of surface density of luminous flux, the substitution of lumens per square foot for "foot candles" was suggested in my paper on "Proposals for a New Lighting Code," in 1943. It was more cogently advocated by Dr. Walsh in a paper read before the Society last session.* Perhaps some will feel regret at the passing of so old an acquaintance as the "foot-candle," but I believe the "lumen per square foot" has much to commend it.

Natural Lighting

The first part of the Code, dealing with natural lighting, is entirely new. It explains the meaning and use of the "daylight factor," and deals with the requirements for good daylighting under the headings of adequacy, distribution, and avoidance of glare. The recommendations for adequacy are made on the basis of an external daylight illumination of not less than 500 L/sq. ft., and a diagram is provided showing the variation, throughout the year, of the daily period during which the external illumination may be expected not to fall below this value. Later in the document, on page 14, an illumination chart for natural lighting is given and, from this, the daylight factors necessary for different "visual tasks" can readily be ascertained. An important recommendation, however, is that for an over-riding minimum to the amount of daylight which should be admitted to residential and workrooms generally, so as to safeguard health and well-being. To provide this minimum of natural lighting, the daylight factor should not be less than one-half of one per cent. over one half of the area of the room. Other recommendations relate to the angle of elevation of the head of the window lighting any "working point" in a room, to the avoidance of glare, and to the mixture of daylight and artificial light.

Artificial Lighting

This is dealt with in the second part of the Code, and the first recommendation is that an installation for artificial lighting should be considered as much an integral part of any building as are the windows provided for its natural lighting. The building should, therefore, be completely equipped for artificial lighting at the time of construction.

Quality of Lighting

Fourteen of the twenty-six clauses in Part II. of the Code are concerned with "quality" of lighting. Great im-

* The Relationship between Interior Design in Building and Artificial Illumination. J. W. T. Walsh. Trans. Illum. Eng. Soc. (London), X.6., June, 1945.

portance is now attached to this, although, for the most part, what is meant by quality is really a matter of proper values of illumination, or brightness. In theory, at least, values of illumination, or of brightness, could be specified for every part of an interior and its contents, and such a schedule of *quantities* could be one for good quality lighting, except for the matter of spectral composition which, however, could also be specified in quantitative terms. The actual provision of every such specified value for a given interior might be exceedingly difficult, and precision lighting to this degree is never likely to become general practice. So, the Code deals with quality of lighting in precise quantitative terms only in reference to the control of glare.

The distribution of light is the subject of clauses 19 and 20, and, in connection with this, a specially designed table is given showing the approximate distribution of light from units of five recognised types, as well as other characteristics associated with lighting by means of each type of unit.

Glare

Clause 26, dealing with the control of glare in general, states that the permissible brightness of lighting units for general lighting can be related to the planned illumination on the horizontal plane, and that this relationship should be such that the ratio which the numerical value of the illumination bears to the numerical value of the lighting unit brightness becomes smaller the greater the illumination. This condition would be fulfilled if the brightness, in candles per square inch, of the lighting units used is made numerically equal to the square root of the number of lumens per square foot required on the horizontal "working" plane.

Thus, for 10 L/sq. ft., the maximum lighting unit brightness, within the angle of view prescribed, would be about three candles per square inch, while for 100 L/sq. ft. it would be 10 C/sq. in. These values are, in fact, in good agreement with those that, on the evidence considered by the Committee, appear to be satisfactory.

A rule of this kind, however, is not very practical, since its strict observance would only be possible if suitably graduated ranges of lighting fittings were available. It can be followed as far as may be practicable, but the rule is simplified in the Code, so that only three standards of brightness are specified, and these are related both to the planned illumination and to the mounting height of the units. Obviously, by this method, conditions will be worsened at the illumination value, or mounting height, at which a jump occurs from one limiting brightness to the next, but this cannot be avoided.

The control of glare in particular cases, namely, in corridors and stairs, in local lighting for industrial premises, in schools and in dwellings, is dealt with by separate recommendations. In every case, the angle within which lighting units having a brightness exceeding given limits shall not be visible is clearly defined as an angle subtended at the viewing eye, five feet above the floor, by two lines, one of which is the perpendicular from eye to floor.

Values of Illumination

For industrial and office building interiors, except such parts thereof as are only in casual occupation, a general minimum illumination of six lumens per square foot is recommended as an amenity.

Apart from this, the illumination required for comfortable, rapid, and easy seeing of specific visual tasks depends upon several factors, such as the distance from the eyes and the

actual dimensions of the objects that have to be seen, their colour or reflection factor, and the contrast between these and the corresponding properties of neighbouring objects. Visual tasks can be appraised in terms of these factors, and the illumination required can then be found on reference to an illumination chart designed to cover six categories of size and three ranges of reflection factor difference. The full range of illumination values extends from one to one thousand lumens per square foot, but values exceeding 100 lumens per square foot are only intended for local lighting. The range is divided to give a geometric series of values, the common ratio of the series being the sixth root of ten. Every value in the series is, therefore, approximately 50 per cent. greater than the next lower value, an "illumination step" of this magnitude being about the smallest that is practically useful. It is pointed out that the majority of visual tasks involve a moderate difference of reflection factors of object and background, so that the second or "B" scale of values in the illumination chart will commonly be used, and this scale extends from 3 to 300 L/sq. ft.

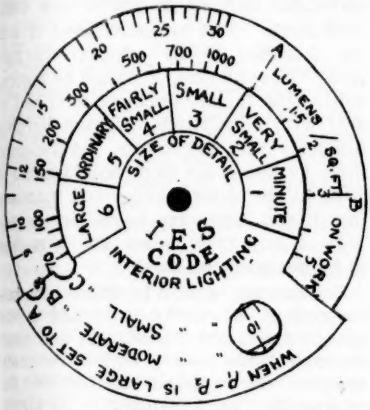
The illumination chart is intended for finding the illumination required on the "work," or on "objects of special regard," and in many cases this will not be the general illumination required throughout the interior. The general illumination must, however, be suitably related to the local illumination, and an empirical rule for this relationship is given in clause 36 of the Code. The rule is presented in the form of two scales, the upper one representing values of local illumination, and the lower one giving minimum values of general illumination. Inspection of these scales shows that the upper scale is formed by squaring the values along the lower scale, and some explanation for this is needed.

It is well known that the ratio of *brightness* of object to *brightness* of general surroundings should not be too high, and it has been commonly accepted—on physiological considerations—that this ratio should preferably not be higher than about 10 : 1, and certainly not higher than 100 : 1. The Code rule is given in terms of *illumination* values, not of brightness values, and the Committee's task was to formulate a simple and workable rule, in these terms, by which, in the majority of practical cases with which the lighting engineer has to deal, acceptable brightness ratios can be achieved.

If the average reflection factor of the general surrounds was always equal to that of the local field of attention, the rule might be that the general illumination should not be less than, say, one-tenth of the local illumination. But, even so, with the higher values to which the illumination scale is now extended, this would involve values of general illumination which, though feasible, are not yet likely to be often accepted. The rule adopted meets this objection, by carrying the minimum general illumination no higher than the perfectly practicable value of about 30 lumens per square foot. At the same time it is a simple rule, which will generally achieve the desired end, but a rigid observance of any such rule, while it should prevent bad results, will not in every case ensure the best results. To achieve these, the lighting engineer must not be a slave of generalisations.

The remaining clauses of the Code call for no special comment, but they are followed by notes on the assessment of the illumination required for different visual tasks which should be valuable to the user of the Code. The

Code is completed by a schedule of pre-determined values of illumination for seeing in various interiors, and for numerous specific operations depending upon vision. This schedule is similar to that included in the previous version of the Code, but a single value of illumination is given for each item, instead of a range of values. The single value, however, applies only to the "average case" of the class of interior or operation listed, and to provide for cases which deviate from the average, a grade number and letter is given for each item. The number refers to a size category, and the letter to a reflection-factor-difference category, and this is merely a method for indicating a range of values.



A simple Pocket calculator for the estimation of the illumination requisite for a given visual task.

Finally, it may be of interest to note that the synthesis of the illumination required in any given case, on the basis of a factorial analysis of the "visual task," and in accordance with the recommendations of the Code, can be effected with the aid of a simple pocket calculator such as that shown in the accompanying drawing.

DISCUSSION

Mr. H. E. CHASTENEY said he looked at this matter from the point of view of a Factory Inspector, the man who had to administer Section 5 of the Factories Act which required "sufficient and suitable" lighting. A Lighting Code could be of immense value in assisting an Inspector to interpret this requirement of the Act, and personally, he regarded the new Code as a great improvement on the previous Code in many respects. For instance, there was now a section on daylight, and emphasis was also laid upon the quality of the lighting provided. Then there were the various charts and tables, and the one on page 15 of the Code relating to artificial lighting interested him very much because it took into account the fact that the degree of contrast in industrial processes often varied enormously. Then there was the chart on page 18 which gave him, for the first time, a clear impression of what was meant by the various size categories and it showed a sort of scientific basis on which the schedule of values was drawn up. The authority of the Code depended not only on the standing of the body issuing it, but also on its degree of acceptance by industry—he referred to the reasonably open-minded section of industry—and the Courts. What was the practical test which the factory manager would apply to the Code? Probably the first thing he would look at was the Schedule and he would look for something in it which closely approximated to a particular process in his factory. Then he would consider whether the value given in the Schedule was the right and proper one—and it was not an easy matter to assess these values. It might be done by means of the chart in a number of cases, but that was not universally applicable. Therefore, great care must be taken with these figures. The assessor must not put the figure extravagantly high nor must he be timid and put the figure too low. It was not an easy course to steer, but it could be done. He thought the Committee was to be congratulated on an excellent piece of work and that they would be the first to acknowledge that

the lion's share of the credit was due to the President himself.

Mr. J. B. CARNE said that as a member of the Code Committee he fully supported the recommendations contained in it. The standard of the recommendations was, he thought, high. Nevertheless, he thought the Committee right in putting them forward and the Society right in adopting them.

Mr. Chasteney's remarks regarding the acceptance of the Code by factory managements led him to comment on the schedule of recommended values given at the end of the Code. On seeing the Code in print for the first time a few days ago, he felt that the title of "Good Lighting" on the title page was hardly correct, since "good" implies mediocre. He thought it would be agreed that lighting fulfilling the requirements laid down would be not merely good but excellent. If one referred back to Mr. Weston's paper of 1943, it would be found that the values now recommended were those which enable a high visual performance to be attained—about 90 per cent. of that possible when an unlimited amount of illumination is provided on the task. Now in striving for perfection, it was always the higher increments, such as the step-up from 80 per cent. to 90 per cent., of perfection, which were the most costly; for, since increase in visual efficiency is proportional to the logarithm of the illumination, it follows that it is also proportional to the logarithm of the cost. He did not know exactly where, but he felt that somewhere in the Code indication of this relation should be made so that the user might have some guidance to the economics involved in providing for various standards of visual efficiency. It should not be considered that because the basis of the Code is strictly scientific reference to the relevant economics need not be made. On the contrary, such a reference is called for, and would help in preserving a sense of proportion in the application of the Code recommendations.

Mr. G. CHELIOTI, speaking as an industrial user, said he had been greatly impressed by the new Code. If it were intended for the architect and the constructional engineer, well and good; but if it were intended to enable the industrial user to design his own lighting installation, then, of course, it was quite inadequate. But he understood it was not intended to be adequate in that sense. Nevertheless, it should be a great help to the factory engineer who had to deal with a multitude of small lighting problems from day to day. At the same time, he hoped the Code would make it clear to the factory owner and manager that it was necessary to call in the advice of an expert when anything had to be designed basically.

Continuing, he said he shared the uneasiness of Mr. Carne in regard to the use of the word "good" in the title. Perhaps "adequate" would be more suitable. He certainly did not like the expression "good lighting." It all involved the problem of efficiency in seeing, but then the question would probably be asked, "What is efficiency in seeing," and it was a difficult problem to define such a subjective thing. The physiological effect, of course, should be that one was unconscious of the lighting and could see effectively for the purpose in question. For the benefit of the tyro, perhaps, the Introduction to the Code might have been extended by a paragraph on units, especially as one or two unfamiliar units had been introduced.

It was stated that no part of the sky should come within the range of vision of a person in a room, but that seemed very difficult to achieve short of completely blacking-out the windows.

Continuing, he said he felt a certain pang at the disappearance of the foot-candle, and he was not at all sure that it was entirely rational to abandon its use, for we still used the candle per square inch for the brightness of light sources, and if we used lumens for the receiving end, why not use them for the emitting end?

As to the references to a colour similar to daylight, he said there were not really any light sources for local illumination that gave a colour approximating to daylight. Fluorescent tubes were

a good approximation, but they were not particularly suitable for local illumination. The old daylight lamps were highly inefficient, and he would like to know what the Committee had in mind in referring to a colour similar to daylight.

He would like to ask Mr. Chasteney about the effect of the war on industrial illumination. For six years he had had to deal with a number of factories, and it had by no means been all jam. First there was the black-out, which not only involved lighting but also ventilation problems, and many factories were improved in both respects, but care must be taken that the reverse process did not take place now the war was over, and that people should think there were no more lighting problems. He had had the experience of putting up factories at the expense of one of the Supply Ministries, and in every case the proposals as regards lighting were seriously cut down. In the case of one factory having an area of 100,000 sq. ft., the use of discharge lighting was prohibited and incandescent lamps were insisted upon. Now it was desired to continue that factory for peace production, and it was badly illuminated, and it was now much more difficult and expensive to change the illumination. Therefore he hoped now that Government Departments were taking a greater share in the affairs of industry, not only the Factory Inspectorate but others concerned would take a wide view of this important subject and would help industry instead of hindering it in the manner he had indicated.

Mr. A. R. McGIBBON also regretted the passing of the "foot-candle," which, he said, everybody understood. The Continent did not speak of "lumens per square metre." They used the "lux." Could not we consider some unit such as the "Trot" or the "Beut" as a tribute to Mr. Trotter or Mr. Beuttell? He was glad the Code included daylight, but he gathered that the daylight level of lighting was to be equal to that provided by artificial lighting. That was rather surprising to him because he had been into factories during the war where the black-out obscured some of the daylight and the artificial lighting was used to supplement the natural lighting. Under these conditions the artificial lighting was frequently quite inadequate, but the same standard of lighting was sufficient under night conditions.

He would have expected that a higher degree of artificial illumination would be necessary during the day in such circumstances, particularly at the lower end of the scale, and asked whether any investigations had been carried out along these lines in order to arrive at some multiplication factor.

He thought the new Code would be generally appreciated, as, for the first time, it attempted to show how the values of illumination were obtained.

Mr. C. A. MORTON expressed his disappointment with the draftsmanship of the Code and the diagrams on pages 10 and 12, which seemed to be out of keep with a report of such a high standard. He also was sorry to see the "foot-candle" disappear. Lumens per sq. ft. were essential for all calculations, but on the job "foot-candles" was an expression which was sharp and to the point. Referring to the diagram giving the range of types on page 18, he said oculists had a standardised range of type for testing purposes, and he would have preferred the adoption of some standard form of type in this diagram.

Mr. P. S. BARTON suggested that nothing be said in the title of the Code as to whether the lighting recommended was either good or excellent. He could not imagine a drainage engineer or a heating engineer talking of good drainage or excellent heating systems. They simply said that what they proposed was the way to do the job, and he did not like the idea of illuminating engineers almost apologising by saying "this is good lighting." The word "good" should be cut out of the title altogether and so prevent the user from being tempted to reduce what the Code suggested.

Mr. R. O. ACKERLEY supported the suggestion to omit the word "good" from the title of the Code and thought it should be called "The I.E.S. Code of Lighting." Whilst welcoming the dis-

appearance of the "foot-candle," he urged that everything must be done to get the "lumens per sq. ft." universally adopted in this country and in all English-speaking countries.

Referring to Clause 14, paragraph 3, of the Code, which stated that where a person could not get over 3 per cent. he could put in a lower daylight factor not below 3 per cent., he asked what happened where 3 per cent. could not be obtained. It should be brought out more strongly that it should be supplemented with artificial light.

With regard to Table 18, he said the top row of figures were very minute, and he personally could not see them in any light. He also asked what happened to the illumination recommendations where people used magnifying glasses. Would the illumination be cut down?

Finally, he said he was greatly impressed by Mr. Weston's calculator and suggested Mr. Weston should go ahead with it or that the I.E.S. should purchase the rights from him and produce it themselves. It would be a very useful help to the lighting engineer and be a very good thing for the prestige of the Society at the same time.

Mr. E. B. SAWYER joined issue on the question of illumination values. His impression was that the Schedule was intended to represent the minimum illumination for visual comfort, but it was not possible to tie up 7 lumen sq. ft. for staff rooms with the definition of good lighting on page 4 of the Code. The same criticism applied to the values for industry. While the values given were based on 90 per cent. visual performance, no account was taken of the psychological effect of higher values of illumination. This Code merely set out the minimum requirements, whereas he felt the Illuminating Engineering Society could very well present much higher values to enable people to work in real comfort. He did not at all agree with Mr. Carne that users would be tempted to adopt lower values, especially as some were already using higher.

Mr. ATKINSON thought it was a mistake to drop the "foot-candle" because once a start was made in changing units, it was not always possible to stop just where the beginning was made. For instance, in the case of non-luminous surfaces, they had, in the past, been measured in "equivalent foot-candles." Were we, in future, to speak of "equivalent lumens per sq. ft."?

Mr. HARRIS said he would have liked more stress to have been laid in the Code on good maintenance. It was not merely sufficient to set out the conditions of a good installation in the first place. He had known installations where the illumination had fallen off by 25 per cent. of the calculated service figure in a very short time or about 15 per cent. of the original illumination solely because of inefficient maintenance. That matter should also be included in the Code.

Mr. F. C. SMITH said he had always been alarmed at the upward trend of illumination values, although he knew he would be unpopular in saying so. The fact that lighting values were being continually stepped up suggested an absence of fundamental knowledge which enabled us really to ascertain what was required. He welcomed this Code because he believed that as far as our present knowledge went it was an attempt to put the thing on some sort of scientific basis. It might be that certain values in the Code, as Mr. Sawyer had suggested, had not been very well assessed. Perhaps some of the fundamental factors that should have been taken into account had been missed, and as a consequence some of the values had been stepped down below what was really desirable, but he would like the Society to give a definite lead based on fundamental knowledge and not follow the tendency always to be stepping illumination values.

He had been very interested in what Mr. Chasteney had said as to the reaction of the factory managers to this Code. Whilst there were circumstances in which the higher levels of illumination were necessary there were others in which lower levels could be used and still obtain satisfactory illumination.

Therefore, it was essential to remember that the running costs increased pro rata with the illumination values and more harm than good would be done to the cause of efficient lighting if this tendency continually to step up values was persisted in irrespective of the fundamental facts.

Mr. WESTON, replying to the discussion, said that all the points raised would receive careful consideration by the Code Committee. The new Code would be subject to revision as its predecessors had been, and the matters mentioned in the discussion would be taken into account.

He did not quarrel with the suggestion to leave the word "good" out of the title, although a great deal of thought had been given to it already. At the same time it had been considered necessary to emphasise that the Code was one for good lighting, having regard to the fact that mandatory requirements in factories amount to a Code for lighting which is not so good, and that our own recommendations, though good, are not ideal.

Mr. Chelioti had mentioned a reference in the Code to the view of the sky through windows. Perhaps the intention had not been very well expressed, but what was meant was that no part of the sky should be visible within the normal field of view of anyone engaged on a visual task, i.e., when actually looking at the job. It was not meant that in walking about a room or factory the person should not have a view of the sky. As to the reference to a colour similar to daylight, this was meant to apply to conditions where daylight had to be supplemented permanently, or for a long period. Then there should be some form of artificial lighting which blended well with daylight. He agreed that at present there were no small light sources similar to the colour A fluorescent tube available for local lighting, but it was hoped they would be available before long. As to the abandonment of the term "foot-candle," he thought we should get used to that, although there might be difficulty in changing some of the other terms. The point made by Mr. Atkinson in this connection would have to be seriously considered.

What values of illumination should be recommended when magnifying glasses are used is not an easy question to answer. When it is known that they are regularly used, then it might be appropriate to adjust the values accordingly.

As to the low value for classrooms, mentioned by Mr. Sawyer, he did not think the Code actually referred to classrooms as having a value of 7 L/sq. ft. The figure of 15 lumens per sq. ft. was mentioned, and that was above the value recommended in the Report of the Committee on the Lighting of Buildings.

The economics of lighting had been mentioned, but he did not think there need be any alarm from that point of view. Personally he did not think the values mentioned in the Code were at all excessive or likely to be very costly to provide, since the higher values would only be required locally. His own view was that economics should not be considered in drafting such a Code as this. The Code should point out what was necessary for good lighting, and if anyone could not afford it, that was unfortunate; they must then get as near to the Code values as possible. But he believed the recommended values could be obtained without any alarming increase in cost. In reply to Mr. Morton he said there had been difficulties owing to shortage of time, and in subsequent editions the diagrams would be improved upon.

The CHAIRMAN, proposing a vote of thanks to the President, coupled with it the name of Mr. Carne, who had done such excellent and enthusiastic work as Secretary of the Committee.

Continuing, he said that one point which had not come out in the discussion was that in Clause 35 it was emphasised that the recommended illumination values should be obtained on the visual task of the worker. In the previous version, general levels of illumination were specified so that it was possible to furnish sufficient general illumination without necessarily providing the light where it was really wanted.

SESSIONAL MEETING IN LONDON

A Sessional Meeting was held at the E.L.M.A. Lighting Service Bureau, 2, Savoy-hill, London, W.C., at 6 p.m. on Tuesday, December 11, 1945, Mr. H. C. Weston (President) in the chair.

The Minutes of the previous meeting having been taken as read and confirmed, the President called upon Dr. J. N. Aldington to deliver his paper, "Bright Light Sources," which was illustrated by numerous interesting demonstrations and experiments, and was heard with great interest by those present.

In the ensuing discussion Mr. L. J. Davies, Dr. Truscott, Mr. E. A. H. French, Mr. V. J. Francis, Mr. F. K. Bourne, Mr. C. A. Hughes, Mr. J. S. Dow, Mr. J. S. Preston, Mr. C. B. Bicknell, Mr. A. G. Penny, Mr. Hill, Mr. Martin, Dr. J. H. Nelson, and others took part.

After Dr. Aldington had replied briefly to the discussion, he was accorded a very cordial vote of thanks for his very interesting paper, and the meeting terminated.

I.E.S. FELLOWSHIP

The following applications for Fellowship have been accepted:—

A. W. Allan.
W. G. H. Chilvers.
J. C. Forsythe.
Edgar Howard.
W. H. Jones.
Daniel Ross.

Additions to List of Members

The following applicants have been duly elected by the Council to membership in the Society, and their names have been added to the list of members:—

SUSTAINING MEMBERS:

A. J. Wright and Co.....*Representative*: Mr. G. Jelley, 60, Victoria Street, LIVERPOOL 1.

CORPORATE MEMBERS:

Baker, C. F. G. .....55, Barnfield Road, Ealing, LONDON, W.5.
Church, R. H. .....16, Broadwalk, Pownall Park, Wilmslow, CHESHIRE.
Downing, H. E. .....8, Kingsway West, Westlands, Newcastle, STAFFS.
Edwards, J. .....66, Rye Bank Road, Firswood, MANCHESTER 16.
Hunter, I. W. .....13, Laverockbank Terrace, EDINBURGH.
Phillips, W. C. .....C/o B.T.H. Co., Ltd., 26-27, St. Mary Street, CARDIFF.
Quigley, Ian .....7, Furham Field, Hatch End, MIDDLESEX.
Shaw, A. J. .....243, Bradford Road, Castle Bromwich, WARWICKSHIRE.
Ramaswami, H. K. ...C/o The Sth. Wales Power Company, St. Mellons, CARDIFF.

TRANSFER FROM COUNTRY TO CORPORATE MEMBERSHIP:

Bailey, W. C. G. .....80, Heathbank Road, Higher Blackley, MANCHESTER.

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

With a view to avoiding possible confusion with other publications, reference to these Transactions should be in the form :—" Trans. Illum. Eng. Soc. (London)."

Printed by ARGUS PRESS, LTD., Temple-avenue and Tudor-street, London, E.C.4, England